NASA Facts

National Aeronautics and
Space Administration

Marshall Space Flight Center
Huntsville, Alabama 35812

Effect of Prolonged Space Flight on Human Skeletal Muscle (Biopsy)

Missions: Expedition Five, preflight and postflight through current mission
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Overview

As engineers develop technologies that will carry humans to Mars, scientists search for ways to make sure space travelers will arrive on the Red Planet healthy and ready to explore—and return to Earth healthy, too.

One of the human systems most affected by extended stays in space is the neuromuscular system. Past space missions have shown weightlessness can cause deterioration of muscle fiber, nerves and physical strength.

Astronaut Leroy Chiao, Expedition 10 commander and NASA ISS science officer, equipped with a bungee harness, exercises on the Treadmill Vibration Isolation System (TVIS) in the Zvezda Service Module of the International Space Station.

Crew members on the International Space Station are paving the way for future Mars missions, by allowing researchers to take biopsies of their calf muscles before and after their stay on board. This will allow scientists to begin developing an in-space countermeasure exercise program aimed at keeping muscles at their peak performance during long missions in space. NASA fuels discoveries that make the world smarter, healthier and safer.

Facility Operations

The "Effect of Prolonged Space Flight on Human Skeletal Muscle" experiment seeks to establish the basis for reductions in limb muscle size, force and power at the cellular level that are induced by microgravity—the near-weightlessness of space. Such studies also will explore why muscle is more susceptible to tearing upon return to Earth's gravity from space. Additionally, this research will determine how long it takes for microgravity to affect skeletal muscles, so predictions can be made regarding muscle changes that may occur on a roundtrip flight to Mars.

To help establish the cellular effects of weightlessness, biopsies are taken from the gastrocnemius and soleus calf muscles 45 days before launch, and again immediately upon return to Earth. The gastronemius is the muscle commonly called the calf muscle. The soleus, responsible for flexing the foot, starts just above the ankle and runs under the gastrocnemius.

Magnetic resonance images also will be taken of the calf muscle 90 and 30 days before launch, and again one and 21 days after return to Earth.

Calf muscle function tests will be conducted 90, 60, 30 and 15 days before launch to the Space Station, and again seven, 14, 21 and 30 days after return to Earth.

Crew members will keep daily exercise logs starting at 112 days prior to launch, on board the Space Station, and for 21 days after return to Earth.

Flight History/Background

A series of human physiology experiments during the Space Shuttle STS-78 Life and Microgravity Spacelab mission in June 1996 focused on the effects of weightlessness on skeletal muscles. Astronauts provided biopsies before and after flight, and exercised in space using a Torque Velocity Dynamometer to measure changes in muscle forces in the arms and legs. This mission provided the first set of data for use in determining how long it takes for change in skeletal muscle structure and function to occur.

Current Expeditions build on that 17-day mission. Results are needed from the longer stays in space which the International Space Station can provide, before longer crewed missions exploring deeper into space can take place.

Benefits

Crew safety is NASA's top priority when planning human space exploration. The results of this research will be used to calculate specific changes that will happen to muscles on a flight to Mars and back, so effective countermeasures can be developed, ensuring the arrival—and return—of a healthy crew.

For more about International Space Station science experiments, visit: **www.nasa.gov**

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